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Autopoiesis and the Evolution of Information Systems

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Autopoiesis and the Evolution of Information Systems¹

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ABSTRACT

In this paper we explore the relevance of the theory of autopoiesis for understanding the evolution of information systems. We use the theory as a metaphor which highlights three themes: (1) How systems construct their own environments, (2) how the system's organization of itself and its environment shape the conditions for their success and failure, and (3) how systems deal with changes that are destructive to their identity. Evolution in this perspective is seen as the construction and maintenance of an identity instead of adaptation to external changes. The environment only exists through perception and is organized in such a way that it facilitates the reconstruction of the identity. The theory draws attention to the dynamics that constitute the process of evolution, instead of focussing on the outcome of processes of evolution. We illustrate these ideas by describing a case study of an information system that remained relatively stable over a period of thirteen years in a context of massive changes.

Keywords: Information systems, evolution, change, autopoiesis.

1. INTRODUCTION

The relation between organizational change and information systems (IS) has received much attention in the information systems literature (e.g. [15], [22]). Much of this research has concentrated on the effects of organizational change on information systems and vice versa. Such research has generated rich insights in the facilitating as well as constraining role of information systems in the process of organizational change. Many analyses assume a distinction between the system and its environment, the organization. Information systems are seen as being relatively stable entities while the environment is a source of change and uncertainty. Such a perspective stresses the need for a continuous adaptation of the information system to its dynamic environment.

In this paper we challenge this conception of the relation between information systems and organizational change by outlining a perspective that focuses on the *process* of evolution itself that leads to the effects commonly researched in the IS literature. This reflects a wider interest within the study of information systems and organizations that calls for a richer understanding of the generative mechanisms through which information systems and organizations evolve ([14], [21], [5], [6], [8], [11], [7]). Evolution, in this view, is not conceived as a trajectory of improvement, which leads to a desired end-result through several phases but as a process of which we need to explore its inner workings. We then

might develop a richer insight as to how and why information systems and organizations change and stabilize, irrespective of the effects they produce.

In this paper we draw on the theory of autopoiesis, a recent biological theory which sheds new light on the evolution of living systems and which might be relevant for the evolution of information systems as well. In this theory the common relation between a system and its environment is blurred. The environment only exists through perception, and thus is part of the system. Change, in this view, is generated internally and evolution is not a process of adaptation but of maintaining the system's self-identity. We attempt to apply the ideas of autopoiesis metaphorically to the evolution of information systems, which we illustrate with an empirical study, and we present some theoretical implications of this perspective.

The next section presents a short overview of autopoiesis with respect to the issues that are relevant for our purposes. In the third section we will outline how we use autopoiesis for the analysis of the evolution of information systems. The ideas that are metaphorically derived from this theory are illustrated in the fourth section by drawing on a case study of the evolution of an information system over thirteen years. Subsequently we analyse the case by drawing on autopoiesis and discuss our findings in the light of contemporary social theory. In the sixth section we end the paper with the conclusion that autopoiesis opens new and interesting lines of thinking about change in and of information systems.

2. THE THEORY OF AUTOPOIESIS

Maturana and Varela have formulated the theory of autopoiesis in the early 1970s as an explanation for the nature of living systems [16]. The term autopoiesis is adopted from Greek and means self-production. The theory is a new approach to systems thinking. The central idea of autopoiesis is that living systems produce themselves. The system's components and processes jointly produce the same components and processes, thus establishing an autonomous, self-producing entity [19]. Autonomy of a system is the key feature of living beings and refers to the ability to specify what is proper to it [17]. The mechanism that makes living systems autonomous is autopoiesis.

The recognition of the autonomy of a living system implies that the traditional distinction between a system and its environment is no longer valid because an external observer makes such distinctions. Instead, autopoiesis poses that a living system continuously constitutes its own boundaries, it perceives its

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surroundings (which Maturana and Varela call the medium) in its

own ways, thereby constructing an environment. In Varela's

words: "We are becoming more and more interested in an

epistemology which is not concerned with the world-as-picture,

but with the *laying down* of a world."

workings of the human brain for example, Maturana and Varela

say that the brain produces images of reality which are

determined by how the brains themselves are structured. In other

words, the patterning of the brain determines the perception of the

world. With those images interaction occurs that may lead to

changes in the organization of the brain, depending on the actual

experience. In this sense, the environment is not 'something out

there' but it is actively constructed by the system itself as part of

its own organization. Hence, the environment needs to be seen as

part of the system. Although a living system operates in a

physical environment, the relation to that environment and the

interaction with it is determined internally. Thus, for example,

certain berries are poisonous for human beings. This is, however,

not the intrinsic property of the berries but dependent on the

physical properties, i.e. the organization, of the human being. For

other living systems, certain birds for instance, the berries may

not be poisonous at all.

attempt to analyze as

if it

were autopoietic. A system

continuously constituted its own boundaries, seemed to have

acquired a high degree of autonomy, and was actively involved in

reproducing and thus maintaining itself.

4. METAPHOR IN MOTION: A CASE STUDY

The case tells us about a financial management information

system at the Dutch Railways, which was developed in 1981 and

continued to exist until 1993. The life of this system is described

parallel to a massive process of change at the Dutch Railways

which, in this period, was transforming from a state-owned and

open-end financed corporation to a privatized and commercial

business. Within the context of these massive changes the

financial information system continued to exist despite the

'match' with its organizational context was lost. Seen in

retrospect, it raises the question how a system that increasingly

did not fit its environment anymore continued to be supported and

financed, and was even redeveloped. For this, we need to

understand the historical context of the organization and how it

responded to change.

Also in 1990 the organization, again, was restructured. The 15 regional units were grouped together into 8 larger units and were given significantly more autonomy. Each region thus formed its own management team, and several new managers and controllers were hired, some of which came from outside the organization. Also, a controller from corporate level replaced the head of the central department of Planning and Control. Several newly formed regions started to develop their own information systems accordingly to their own views and needs, as a former controller remarks:

“New managers in the regions with new controllers, often not from the original organization. Everywhere the wheel was re-invented, and everywhere different.”

Shortly after the new organization was implemented the new head of the central department of Planning and Control had to decide whether or not to continue the project of rebuilding NAMIS, which history he was not familiar with. Several regional controllers under his supervision (who had been involved in the development and implementation of NAM) were in favour of the continuance. The decision was taken to continue the project as the head of the central department of Planning and Control

and vice versa. The system enacts
distinguishing only those aspects that make sense to the system,
and it tends to ignore all that does not make sense to the system.
The system thus decides what is relevant and what not, it imposes
a structure upon its surroundings that makes sense to the system
itself, and it engages in self-referential interaction with its
surroundings so that it is able to relate to perceived developments
in order maintain itself. In this way the system establishes itself as
an autonomous and organizationally closed system that
determines its own boundaries, and selects what is proper to the
system. Let us now assess how this happened in the described
case study.

The case portrays not just the development of a new method, but
also of the socio-institutional set-up, which was needed to let the
system function. After the system had been developed it was
implemented in every region by newly hired assistants who were
supposed to take care of the implementation at each site. Most of
those new assistants later became controllers and entered an even
better position to preserve the system.

or to realize its identity, the system organized and created its own
environment. Further, the introduced method itself is a way of
organizing the environment because it discerned a large number

organizational structure and new systems were of a different nature and could not be ignored. The system appeared not able to adopt the fourth and fifth strategies, at least not in time, and it was abolished.

6. CONCLUSION

In using the theory of autopoiesis as a metaphor to analyze the evolution of information systems we were able to draw attention to the generative mechanisms, the underlying dynamics that determine the continuity of a system. We have seen that a system is able to create its own conditions to be successful, or alternatively for its destruction. Autopoiesis, when used as a metaphor, may provide us with an interesting perspective on the *process* of evolution of information systems. The interesting insight this approach offers, and which was illustrated in the case, is that the main aim of systems is to maintain their identity despite the changes in their surroundings, in contrast to the common view of evolution as adaptation to external changes. It draws attention to how the system is structured to view the world rather than the way the world 'is' [28]. This is not to say that such systems are static but rather that their evolution is determined by the identity the system has gained. Consequently, the evolution of information

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